ROBOTICALLY POWERED SURGICAL DEVICE WITH MANUALLY-ACTUATABLE REVERSING SYSTEM

BACKGROUND

Over the years a variety of minimally invasive robotic (or "telesurgical") systems have been developed to increase surgical dexterity as well as to permit a surgeon to operate on a patient in an intuitive manner. Many of such systems are disclosed in the following U.S. patents which are each herein incorporated by reference in their respective entirety: U.S. Pat. No. 5,792,135, entitled "Articulated Surgical Instrument For Performing Minimally Invasive Surgery With Enhanced Dexterity and Sensitivity", U.S. Pat. No. 6,231,565, entitled "Robotic Arm DLUS For Performing Surgical Tasks", U.S. Pat. No. 6,783,524, entitled "Robotic Surgical Tool With Ultrasound Cauterizing and Cutting Instrument", U.S. Pat. No. 6,364,888, entitled "Alignment of Master and Slave In a Minimally Invasive Surgical Apparatus", U.S. Pat. No. 7,524,320, entitled "Mechanical Actuator Interface System For Robotic Surgical Tools", U.S. Pat. No. 7,691,098, entitled Platform Link Wrist Mechanism", U.S. Pat. No. 7,806,891, entitled "Repositioning and Reorientation of Master/Slave Relationship in Minimally Invasive Telesurgery", and U.S. Pat. No. 7,824,401, entitled "Surgical Tool With Writed Monopolar Electrosurgical End Effectors". Many of such systems, however, have in the past been unable to generate the magnitude of forces required to effectively cut and fasten tissue. In addition, existing robotic surgical systems are limited in the number of different types of surgical devices that they may operate.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following description of exemplary embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

Various exemplary embodiments are described herein by way of example in conjunction with the following Figures wherein:

FIG. **1** is a perspective view of one robotic controller embodiment;

FIG. **2** is a perspective view of one robotic surgical arm cart/manipulator of a robotic system operably supporting a plurality of surgical tool embodiments;

FIG. **3** is a side view of the robotic surgical arm cart/manipulator depicted in FIG. **2**;

FIG. **4** is a perspective view of a cart structure with positioning linkages for operably supporting robotic manipulators that may be used with surgical tool embodiments;

FIG. **5** is a perspective view of a surgical tool embodiment and a surgical end effector embodiment;

FIG. **6** is an exploded assembly view of an adapter and tool holder arrangement for attaching various surgical tool embodiments to a robotic system;

FIG. **7** is a side view of the adapter shown in FIG. **6**;

FIG. **8** is a bottom view of the adapter shown in FIG. **6**;

FIG. **9** is a top view of the adapter of FIGS. **6** and **7**;

FIG. **10** is a partial bottom perspective view of a surgical tool embodiment;

FIG. **11** is a front perspective view of a portion of a surgical tool embodiment with some elements thereof omitted for clarity;

FIG. **12** is a rear perspective view of the surgical tool embodiment of FIG. **11**;

FIG. **13** is a top view of the surgical tool embodiment of FIGS. **11** and **12**;

FIG. **14** is a partial top view of the surgical tool embodiment of FIGS. **11-13** with the manually actuatable drive gear in an unactuated position;

FIG. **15** is another partial top view of the surgical tool embodiment of FIGS. **11-14** with the manually actuatable drive gear in an initially actuated position;

FIG. **16** is another partial top view of the surgical tool embodiment of FIGS. **11-15** with the manually actuatable drive gear in an actuated position;

FIG. **17** is a rear perspective view of another surgical tool embodiment;

FIG. **18** is a side elevational view of the surgical tool embodiment of FIG. **17**;

FIG. **19** is a cross-sectional view of the surgical tool embodiment of FIG. **5** with the end effector detached from the proximal shaft portion of the surgical tool;

FIG. **20** is a side perspective view showing a portion of a interconnected quick disconnect joint embodiment;

FIG. **21** is a cross-sectional view of a quick disconnect joint embodiment with the distal shaft portion of the end effector detached from the proximal shaft portion;

FIG. **22** is another cross-sectional view of the quick disconnect joint embodiment of FIGS. **19-21** wherein the distal shaft portion has been initially engaged with the proximal shaft portion;

FIG. **22**A is a cross-sectional view of a quick disconnect joint embodiment wherein the distal shaft portion has been initially engaged with the proximal shaft portion;

FIG. **23** is another cross-sectional view of the quick disconnect joint embodiment of FIGS. **19-22** wherein the distal shaft portion has been attached to the proximal shaft portion;

FIG. **23**A is another cross-sectional view of the quick disconnect joint embodiment of FIG. **22**A wherein the distal shaft portion has been attached to the proximal shaft portion;

FIG. **23**B is another cross-sectional view of the quick disconnect joint embodiment of FIGS. **22**A, **22**B wherein the distal shaft portion has been disengaged from the proximal shaft portion;

FIG. **24** is a cross-sectional view of the distal shaft portion of FIGS. **19-23** taken along line **24-24** in FIG. **21**;

FIG. **25** is a cross-sectional view of a portion of an articulation joint and end effector embodiment;

FIG. **26** is an exploded assembly view of a portion of the articulation joint and end effector of FIG. **25**;

FIG. **27** is a partial cross-sectional perspective view of the articulation joint and end effector portions depicted in FIG. **26**;

FIG. **28** is a partial perspective view of an end effector and drive shaft assembly embodiment;

FIG. **29** is a partial side view of a drive shaft assembly embodiment;

FIG. **30** is a perspective view of a drive shaft assembly embodiment;

FIG. **31** is a side view of the drive shaft assembly of FIG. **31**;

FIG. **32** is a perspective view of a composite drive shaft assembly embodiment;

FIG. **33** is a side view of the composite drive shaft assembly of FIG. **33**;

FIG. **34** is another view of the drive shaft assembly of FIGS. **30** and **31** assuming an arcuate or "flexed" configuration;